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METHODS OF RACIAL ANALYSIS[1]

SIGNIFICANCE OF THE TERM "RACE"

THE term "race" as applied to man is commonly employed with no accurate and well-defined meaning. One often sees references to the "white race," the "Jewish race," the "Latin race," the "Irish race." Such indiscriminate use of the word "race" implies a confusion of criteria. To speak of the "white" race is to assume that race is a matter of skin pigmentation; to refer to the "Jewish race" is to differentiate race on a basis of religion; a "Latin race" implies a linguistic criterion, and finally any reference to an "Irish race" must mean a race characterized either by geographical position or, failing that, by temperament. Such confusions of usage are usually confined to the non-anthropological writing public. All anthropologists agree that the criteria of race are physical characters. The tests of racial distinction are the morphological and metrical variations of such bodily characters as hair, skin, nose, eyes, stature—differences in shape and proportions of the head, the trunk and the limbs.

Although there exists among anthropologists this general agreement as to the physical basis of race, there is no such unanimity of opinion with respect to the further implications of a classification of mankind on the score of bodily attributes.

One school of anthropologists is disposed to deny that there are any cultural or psychological correlates of race. For these the somatological variations whereby race is determined are of little significance, except as convenient characters for classificatory purposes. They regard them principally and ultimately as effects of environment, though perhaps immediately heritable. Pigmentation may be dismissed by such as a result of climate, stature as a consequence of nutrition, head-form as a manifestation of individual variation or a by-product of separately inherited size-factors. Logically, such anthropologists refuse to recognize that language, material culture, mental capacity or social organization stand in any biological, mathematical or rational relationship to races as determined by these plastic and transitory physical characters. For them race is a congeries of environmentally determined bodily features, significant principally because it effects differences in outward appearance which arouse the prejudice of the ignorant.

[1] Address of the vice-president and chairman for Section H, American Association for the Advancement of Science, Kansas City, Missouri, December, 1925.

A second group of anthropologists, or more properly biometricians, devotes itself principally to the statistical analysis of anthropometric measurements and to the determination of the relationship of such measurements to each other and to various environmental conditions. Under the brilliant leadership of Professor Karl Pearson, these biometricians have developed precise statistical tools, whereby errors incident to the sampling process may be taken into account, variabilities may be reckoned and the relation of variables to each other may be measured by coefficients. These biometrical anthropologists recognize the physical basis of race, but they have not, for the most part, attempted to isolate racial types in the populations which they study. While admitting, doubtless, the racially mixed character of such people as the English they tend to deal with them as if they were racially homogeneous. The late Charles Goring, for example, in his magnificent study of the English criminal divided his large series of convicts into groups classified according to type of offence, and investigated almost every conceivable relationship between their physical characteristics, their mental qualities, their environmental surroundings and the nature of their delinquency. He neglected utterly, however, to distinguish between the various racial types which may have been represented in his sample and attributed such physical differences as he discovered to the influence of social class. In this he exemplified the tendency of the biometric school to study populations as a whole or by selected classes without attempting to distinguish between the various racial types included in them.

A third group of writers on racial subjects, usually not professional anthropologists, associates cultural and psychological characteristics with physical types on wholly insufficient evidence. These race propagandists commonly attribute to the physical subdivision of mankind to which they imagine that they themselves belong all or most of the superior qualities of mankind, physical, mental and moral. They talk of the psychological characteristics of this or that race as if they were objective tangible properties, scientifically demonstrated. Starting from an *a priori* assumption that physical types have psychological correlates, they attempt to refer every manifestation of the psychological qualities assumed to be the exclusive property of this or that race to the physical type in question. Great men of whatever period are claimed to be members of the favored race on the basis of their achievements and sometimes with a total disregard of physical criteria. In no case has any serious effort been made by such ethnomaniacs to isolate a pure racial type and to study either its mental qualities or its material culture. The fact that most if not all peoples are racially mixed is consistently ignored. While some of the conclusions of such writers may be correct, none of them have been scientifically established.

Definitions of "Race"

In the existing confusion as to the connotation of race, it is clear that the term requires exact definition, if any progress is to be made in studies which relate to race analysis or racial problems. I offer the following definition, not with the hope or expectation that it will be generally accepted, but merely in order to elucidate my own position.

A race is a great division of mankind, the members of which, though individually varying, are characterized as a group by a certain combination of morphological and metrical features, principally non-adaptive, which have been derived from their common descent.

A primary race is one which has been modified only by the operation of evolutionary factors, including the selection of its own intrinsic variations and of the modifications, adaptive or non-adaptive, possibly caused by environmental stimuli.

A secondary or composite race is one in which a characteristic and stabilized combination of morphological and metrical features has been effected by a long-continued intermixture of two or more primary races within an area of relative isolation.

Assuming, for the moment, the validity of the foregoing definitions, it is apparent that the present population of the world consists for the most part of secondary races and that primary races are represented only by inbred peoples within areas where little race contact is known to have taken place. Of such inbred peoples only a small fraction represent primary racial types either because they are absolutely unmixed or because pure racial types have been segregated out in relatively few individuals. For man has been a migratory animal from proto-human times down to the present and the contact of races has always resulted in race mixture.

I do not propose to enter into any elaborate discussion as to the specific unity or diversity of existing types of man. Certainly if fertility in interbreeding is regarded as the test of species all present varieties of man must be assigned to one group.

Criteria of Race

The criteria by which race classifications are established are admittedly physical. Furthermore, they are necessarily multiple. No single bodily character exhibits a sufficient range of variation to enable us to assign to each of the great human groups which

require racial classification a distinct and exclusive development of that feature. There are not enough variations of any one feature to go around, unless we confine ourselves to two or three primary and well-nigh hypothetical races. A man's head must be broad in proportion to its length, narrow in proportion to its length or of medium breadth; his hair must be straight, wavy or curly. But there are more distinct types of men than distinct categories of hair-form or cephalic index, and one extreme variant of a bodily feature is not always associated with the same modification of another feature in individuals or in groups. Separate bodily characters in their various grades of development are not necessarily correlated with each other. It follows that racial classifications must be made upon the basis of a sum total of significant morphological and metrical features according to the measured and observed combinations of distinct variations of such features in large human groups.

If race implies the common possession of certain variations as a result of the same ancestry, significant racial criteria should be based principally upon non-adaptive bodily characters. No bodily characters are absolutely unmodifiable, but certain organs are more or less stabilized in their functions, and the less important these functions are, the greater is the probability of hereditary variations manifesting themselves unimpeded and unmodified in such organs. Heredity runs riot in indifferent variations and atrophied organs. The very insignificance of certain features, such as the form of the hair or the thickness of the lips, insures their hereditary transmission in the absence of selected adaptive modifications that have survival value. The human foot, on the contrary, is rigorously adapted and modified for support and locomotion in all varieties of man, and the practically identical requirements of a functional nature tend to obscure and obliterate any racial variations which may have existed or to subordinate them to such variations as may be consequent upon the habits of going barefoot or shod.

I regard the following bodily characters as mainly non-adaptive variations: the form, color and quantity of the hair, and its distribution in tracts; the color of the eyes and the form of the eyelid skin-folds; the form of the nasal cartilages; the form of the lips and of the external ear, the prominence of the chin; the breadth of the head relative to its length; the length of the face; the sutural patterns, the presence or absence of a postglenoid tubercle and a pharyngeal fossa or tubercle, prognathism, the form of the incisor teeth; the form of the vertebral border of the scapula, the presence or absence of a supracondyloid process or foramen of the humerus, the length of the forearm relative to the arm; the degree of bowing of the radius and ulna; the length of the leg relative to the thigh. This list is not, of course, exhaustive. Many of the features enumerated above, and perhaps all of them, may be functionally modified, if the need for such modification arises. For example, the breadth of certain Eskimo skulls appears to have been constricted by the hypertrophy of the temporal muscles. Usually, these characters, however, show no apparent relationship to function, and seem to maintain themselves by the inertia of heredity, occurring sometimes as individual or family variations, and sometimes more widely distributed in racial stocks.

Another group of bodily characters include those the distinctive variations of which may have originated in functional modifications, but which have become so stabilized as to persist in certain stocks even in contravention of their original function. These may also be utilized as racial criteria, subject to a precaution, *viz.*, that they may be remodified in an opposite direction. Among these are pigmentation of the skin, breadth of the face, height and breadth of the nose, size and prominence of the malars, shape and proportions of the hard palate, height of the head, volume of the brain, proportions of the thorax, relative length of the lower extremities, relative length and angle of inclination of the heel-bone and size and development of the calf muscles.

Features that seem easily modifiable in the individual and in the group through the action of environmental factors, and especially by quality of nutrition, diet, gait and exercise, can not be trusted as criteria of race, except in the absence of evidence for the operation of such environmental causes. These include stature, weight, length of the upper extremity, proportions of the hand, most variations of the bones of arm, degree of lumbar curvature and pelvic inclination, most of the variations in the long bones of the lower extremity, including femoral torsion, bowing, pilaster, platymeria, variations of the articular surfaces of the tibia and of the shape of the tibial shaft.

THE APPLICATION OF RACIAL CRITERIA

In the actual practice of racial analysis a number of questions arise as to the relative importance of various criteria and the method of procedure in the application of the different tests. What differences in methods of analysis are involved in the study of living peoples as contrasted with the investigation of skeletal remains? Should stress be laid upon morphological or metrical observations or a combination of both? Is the diagnosis to be made upon the basis of individual combinations or group means? How may we isolate pure racial types?

Let us consider first the application of racial test to living peoples in comparison with the study of

skeletons. Certain obvious advantages obtain in the investigation of the living. The material is more abundant, there is no doubt as to sex identification and comparatively little doubt as to age; data with respect to individual and family history and ethnic affinities are ascertainable, as well as the environmental backgrounds of the people under investigation. Many significant features lacking in skeletal material such as the form of the soft parts of the eyes, nose and mouth, the form and distribution of hair and the pigmentation of the body may be examined.

On the other hand, there are certain disadvantages involved in the study of the living. The personal reactions of the subjects must be considered and opportunities for assembling and subdividing the grouped material are lacking. Each individual can as a rule be observed and measured only once. Measurements on the soft parts are far less accurate than measurements on the skeleton, and most significant skeletal features can not be observed or measured on the living. Certain striking and obvious characters of living subjects are likely to mislead the investigator in his racial analysis. The form and color of the hair is often radically altered by artificial means. Phenomena of dominance tend to obscure relationships in composite races, particularly in pigmentation and the form of the hair and soft parts. A wash of yellow-brown pigment and the dominance of straight, coarse, black hair has, in my opinion, for instance, created a mistaken impression of the physical homogeneity of the American Indian.

The advantages and disadvantages of analyzing racial elements in skeletal material are naturally the opposite of those that obtain in the case of living material. Our present imperfect knowledge of the correlation of variations of the soft parts with those of the bony skeleton renders uncertain many racial determinations upon bones, but studies on the living are subject to the same disadvantage. But in the investigation of early and extinct types of man and of past populations our dependence is naturally upon skeletal material. I am of the opinion that racial characteristics are better defined in the skeleton than in the soft parts. This seems to be the case particularly in the skull. Many individuals of mixed blood, who are fundamentally white, show characters of skin, pigmentation and soft parts which would lead a superficial observer to classify them as predominantly negroid. But the skull and framework of the body may show a basically non-negroid morphology. On the other hand, it is equally true that some persons who appear to be white show definite negroid or mongoloid skeletal features. An ideal method of racial investigation would be to follow the study of the soft parts with the examination of the skeleton in each case, but so far as I know this method is pursued only by Professor Wingate Todd at Western Reserve University, and racial studies are naturally confined to such types as happen to pass through the dissecting room. Correlations of features of the soft parts with skeletal structure may sometimes be obtained in the living by the use of the X-ray, but this method is usually impracticable.

The comparative importance of morphological and metrical observations for purposes of racial diagnosis has not been clearly established. Every student of the subject knows that many of the significant characters of the skeleton and the soft parts are non-measurable. They are, however, capable of classification according to presence or absence, grade of development and form, if the observer is experienced and is able to maintain a consistent standard for his morphological appraisals. These qualitative observations have usually been neglected by students of race because of the difficulty of recording them and of dealing with them statistically. Now, however, thanks to the work of the biometricians, methods have been developed whereby such qualitative observations may be treated mathematically. The method of mean square contingency enables one to express by a coefficient the interrelationships of different non-measurable features within a series, and it is also possible to ascertain the correlation between measured and observed characters. There is now no excuse for neglecting morphological observations.

Measurements have always been favored in the investigation of racial groups, because of their precision and because of the ease with which they may be handled mathematically. But crude dimensions are not often racially significant in the individual, and their value for this purpose is somewhat questionable even when the means of groups and the variabilities are calculated. For this reason it has long been customary for anthropologists to calculate indices which express the relation of one dimension to another as a percentage. These indices are conventionally and somewhat arbitrarily divided each into three or more categories, according as the ratio of one dimension to another is small, medium or large. How far these index divisions correspond with racial variations is a moot question. Certainly it is dangerous to invest these artificial gradations of ratios with the official status of race determiners, without due investigation of their individual and intra-racial ranges of variation. Further, indices seem not to be inherited *in toto*, but the measurements of which indices express ratios may be inherited from the same or different parents, and more than one factor may be involved in a single measurement, not to speak of the individual variations which may crop out. In spite of these

difficulties indices are a convenient and valuable means of expressing group and individual characteristics and should by no means be banished from the assemblage of racial criteria.

Rather more important than the problem of the comparative validity of morphological observations, measurements and indices is the way in which these are utilized. Should the racial analysis be based upon the combinations of metrical and morphological features in each individual included in the group or, on the other hand, upon group means of the various racial characters? Over-emphasis upon combinations of measurements, indices or morphological features in the individual is almost certain to result in the distinguishing of manifold physical types, many of which have no racial significance but are simply manifestations of individual or sex variations. On the other hand, combinations of group means may not represent any individual physical type whatsoever, but merely averages of independently variable characters. It seems to me that the solution of this difficulty lies in a proper realization of the significance of race. Races are great groups and any analysis of racial elements must be primarily an analysis of groups, not of separate individuals. One must conceive of race not as the combination of features which gives to each person his individual appearance, but rather as a vague physical background, usually more or less obscured or overlaid by individual variations in single subjects, and realized best in a composite picture. Nevertheless, if a group is racially comparatively homogeneous, a certain number of individuals will approximate very closely to the appearance of the composite. And the individual who departs farthest from the racial composite is likely to be the one who has the largest admixture of another strain. So it is probable that taking a sufficiently large sample of a relatively unmixed group one will find that the modal type tends to show a combination of approximations to the group means of the various characters. I am therefore of the opinion that the best method of testing the physical homogeneity of a group is to calculate the means and variabilities of separate characters and then to ascertain whether or not the individual types of most frequent occurrence manifest these average values of the separate characters in combinations.

A Method of analyzing Race

A considerable experience in the study of skeletal material and especially of skulls has resulted in the working out of the following method of racial analysis which utilizes both morphological and metrical observations. On each skeleton the usual measurements are taken and the conventional indices are calculated. Morphological observations, carefully graded, relating to every significant non-measurable character, are recorded on appropriate blanks. After measurements and observations are concluded each skull is assigned to a racial type or to some distinctively designated type, according to the anatomical judgment of the observer. Thus a skull may be called "Negroid," "Nordic," "Alpine-Mediterranean," etc., or it may be called some name indicative of a local type, such as "Guanche," "Basket-Maker," etc.

The next step is the statistical reduction of the measurements and indices for the group as a whole, the two sexes, of course, being separated. This involves the calculation of means, standard deviations, coefficients of variation and their probable errors. Percentage distributions of the index subdivisions are also reckoned. The graded morphological observations are likewise analyzed for the whole group, the percentages of each grade of every character being tabulated for each sex separately. We now have determined the general anthropometric and morphological features of the group as a whole, although the qualitative and quantitative data are as yet unrelated.

There follows the comparison of our group as a whole with other entire groups for which comparative data are available, which are possibly related and of which the racial composition may be more or less accurately known. The comparison is effected by taking the differences of the means of the two groups in the case of every measurement and every index. If the difference between the means of the two groups with respect to a given measurement or index is less than three times the probable error of such a difference, the two groups can not be said to differ significantly with respect to the mean of that measurement or index. Coincidences in the means of two or three measurements or indices are not necessarily indicative of relationship, but if a large number of measurements and indices in the two groups show insignificant differences the odds in favor of the two populations being of similar racial composition are greatly increased. When a substantial majority of means of measurements and indices in two series coincide or differ from each other only slightly, we are justified in concluding that similar racial elements have entered into the composition of the two groups, and if we know what the racial elements are in one of the groups we may infer that these are present in the other also. By comparing a number of groups with the one under investigation, one soon finds out the closest affinity of the latter.

The next process is the division of skeletal series into types, with the object of ascertaining the racial affinities of these types. Such classifications according to type may be attempted by several different methods. One is by individual combinations of index

subdivisions, as, for example, dolichocephalic- hyspicephalic- akrocephalic- leptoproscopic, etc. The principal difficulty involved in such a method of index combinations is that the number of individual types is practically limited only by the number of indices utilized in the combinations. For example, if one utilizes four indices, each of which has three subdivisions, the number of combinations possible is eighty-one. In a series of 245 Tenerife male crania thirty-four of eighty-one such possible combinations occurred in individual crania. If n be the number of indices utilized, each of which has three subdivisions, the number of combinations possible is 3^n. If any considerable number of indices is utilized the individual type combinations soon exceed the number of individual crania in the series. Exactly the same difficulty is encountered if one attempts individual combinations of graded morphological features. Utilizing twenty-two morphological features, each having five gradations, I found that no two individual skull curves in a series of 247 Tenerife male crania were alike. It is apparent that such methods do not delimit racial types. Rather they test the number of individual variations of the series, and in racially heterogeneous groups these seem to be limited only by the mathematical combinations of gradations and the number of criteria employed.

I have found what I believe to be a solution of this difficulty. In the routine measurement and morphological examination of individual crania, each one is assigned to a designated morphological type according to the anatomical judgment of the observer. I think that this method of distinguishing racial types on the basis of morphological judgment is the most natural and practical procedure. It would be very difficult for the most skilled anthropologist to decide that a man is a Polynesian from an array of his measurements and indices, whereas the same anthropologist would unfailingly classify the subject as Polynesian after a few moments of careful observation.

When the group has been divided into morphological types by this method the next step is to test the metric and morphological validity of these types. The means of measurements and indices of each type must be compared with the corresponding means of the entire group. The significance of differences in means between the subgroups and the whole series must be appraised in relation to their probable errors. If the morphological types distinguished show significant differences in means of a majority of measurements and indices from the averages of the entire group, it may be inferred that the subgroups represent metrical types. Ordinarily in such cases the standard deviations and the coefficients of variations of the subgroups will be less than those of the entire series. The relationship of these observed types to graded morphological features, individually observed, may be established by making contingency tables and calculating coefficients of mean square contingency. If the observed types are morphologically valid certain significant associations between gradations of morphological features and type classification will be manifest. By the same contingency method it is often possible to establish relationships between the morphological types and combinations of index subdivisions in individual crania. In short, the division upon the basis of morphological type seems to establish subgroups which are metrically, indicially and morphologically relatively homogeneous.

When the subgroups of both sexes have been established according to types and tested for metric and morphological validity, the distinguishing features of the types are very apparent. The series will now consist of several type subgroups, some of which appear to resemble known racial types and others of which may seem to be the result of local combinations. It is now necessary to take the type groups singly and compare them with the most authentic and least mixed series of crania available belonging to the races which the respective types are supposed to resemble. For example, if we have distinguished a "Nordic" type, this type should be compared with series of crania from the German Grave-rows. If on the basis of a comparison of means and probable errors it is found that our "type Nordics" show insignificant differences from the means of the authentic Nordics in the substantial majority of characters investigated, or if the "type Nordics" differ less from any of the authentic series of Nordics than these authentic series differ from each other, it may be concluded that the designation of the subgroup type under investigation as "Nordic" is correct. When the affinities of the supposed racial sub'ypes have been ascertained in this way, the final step in analysis is to examine the mixed types which are presumably due to the crossings of the pure types, and to try to find out what morphological and metrical features have been inherited from the several racial elements.

Whether or not such a method of analysis enables one to isolate pure racial type naturally depends upon the presence or absence of pure types in the population examined and the availability of pure racial groups for comparative purposes. After securing types which seem to predominate of one racial strain it is theoretically possible to select from them the individuals who bear the closest resemblance to the composite racial picture. Or one may attempt to distil the quintessence of the racial type by selecting individuals on the basis of combinations of the non-adaptive features in the gradations of development most typical for the race.

The method described above has been developed in

the study of skeletal material, and, in particular, of crania.[2] I see no reason why it can not be applied equally well to the analysis of data gathered upon living subjects. It is a laborious method involving a large amount of calculation, but necessitating no extensive knowledge of higher mathematics. I have little faith in short-cut methods and no use whatever for personal impressions unsubstantiated by metrical and morphological data properly reduced. If physical anthropologists wish to achieve scientifically valid results they must not content themselves with the presentation of tables of raw measurements, supplemented by their personal reactions by way of interpretation.

If races differ quantitatively in intelligence and qualitatively in psychological characteristics, such differences can be established only by the segregation of pure racial types and the subsequent investigation of their psychological attributes.

E. A. HOOTON

PEABODY MUSEUM,
CAMBRIDGE, MASSACHUSETTS

POPULAR ASTRONOMIC EDUCATION IN EUROPE[1]

IT was my privilege to visit astronomical observatories from the University of Upsala in northern Europe to the Vatican in the south, thus establishing contacts with the directors and other astronomers, and conferring with them about our project at the American Museum. All the astronomers that I visited showed a real interest in our proposed astronomical hall, and some contributed practical suggestions of value.

OBSERVATIONS

The director of the Vatican Observatory, Father J. G. Hagen, who by the way is a naturalized American citizen, strongly recommended the installation of a small telescope which could be used by visitors for viewing objects in the sky. This would not be for professional astronomical work, however, as our institution should not be an observatory, but rather a museum of astronomy. The objective lens of this telescope need not be larger than five or six inches in diameter. This advice of Director Hagen is strengthened by the popularity of the so-called *Uranias* of Europe. I am convinced that this is an excellent proposal and hope that place can be found for a small dome in which may be installed such a telescope.

Professor Elis Strömgren, director of the Astronomical Observatory at Copenhagen, had visited the Zeiss Projection Planetarium in Munich and was tremendously impressed with it, and several astronomers advised me to visit the *Urania* in Berlin, as well as the one in Vienna and the one in Zürich. These *Uranias* are popular observatories in which the people may, for a small fee, observe on any clear night celestial objects through a fair-sized telescope. These observations are aided and directed by a trained person who explains what is seen. When the sky is clear enough for observation, a red light is shown on the *Urania* building. Usually two lectures with observations are given, one rather early in the evening (eight to nine o'clock) and one rather late (ten-thirty to eleven-thirty o'clock). There was a large sign at the door of the Vienna *Urania,* stating that if the sky was clear on that night the following objects could be satisfactorily seen: Jupiter, Uranus, the star-clusters in Perseus and the great nebula in Andromeda. The *Uranias* are also open during certain hours of the day for the observation of sunspots with the astronomical telescope and for the viewing of mountains and other distant objects with a terrestrial telescope. How well established these *Uranias* are in Europe is indicated by this significant fact that both in Vienna and in Zürich the street passing the *Urania* is called *Uraniastrasse.*

The Astrophysical Observatory at Potsdam is one of the best constructed, one of the most complete and one of the most modern of those visited in Europe. Here, among other things, I examined their new Einstein Tower, which they believe to be an improvement on the one at our Mt. Wilson Observatory. With this equipment they will test the Einstein theory by measuring the displacement of the Fraunhofer lines, the spectrograph connected with this tower being very much more efficient than that connected with any refracting or reflecting telescope. The spectrum is spread out in a large room, which no one enters, and which is kept at a temperature constant to one one hundredth of a degree.

In Florence the Astronomical Observatory and Galileo's tower, which is restored, were visited. In the Museum of Physics I was greatly interested to see the two original telescopes of Galileo, with which he first saw the moons of Jupiter, the fiery ring of Saturn, the spots on the sun, the mountains on the moon, and Venus as a waxing and waning crescent.

[2] This method has been employed in the author's recent publication "The Ancient Inhabitants of the Canary Islands," Harvard African Studies, Vol. VII, Peabody Museum, Cambridge, Mass., 1925.

[1] In preparation of the plans for the Hall of Astronomy, for the use of students of all grades, which is now under consideration by the trustees of the American Museum of Natural History, Dr. G. Clyde Fisher was sent abroad during the summer of 1925. There is here printed an abstract of his report.

The director of the museum of physics allowed me to photograph these telescopes. In two museums visited—the German Museum in Munich and the Science Museum in South Kensington, London—there are models or replicas of Galileo's telescopes. Similar models would be objects of interest in our astronomical hall.

In the Paris Observatory our own astronomer, George W. Ritchey, who made the 100-inch disc for the big reflector at Mt. Wilson, was at work, attempting to make much larger discs than ever have been made before and on an entirely different principle. His new discs are of glass, but they are not solid. They are made of many pieces in such a way that the completed disc is ventilated and very much lighter than the old solid discs. The Paris Observatory is famous for its astronomical records, especially those dating back to the early days. It is also famous for its international time department, in which every instrument was demonstrated for me. Among other things, permanent records were being made of radio signals from Annapolis.

ASTRONOMIC MUSEUMS

More important to me than astronomical observatories, and more important even than *Uranias,* were astronomical museums, the greatest of which was the department of astronomy in the German Museum in Munich. There is no doubt that this is the finest museum of astronomy in the world. Here more than twenty rooms, halls, terraces and domes are fitted with objects of astronomical interest. No guide-book or catalogue of these exhibits was to be had, except a partial or fragmentary one in the general guide-book to the museum. So, after several hours of concentrated work, I made a complete list in considerable detail of these exhibits. There is not space in this report for even a bare list of these, but I hope to go over them quite carefully with Mr. Howard Russell Butler, advisor to the architects. Here were found a number of things which Mr. Butler had thought of independently, for example, a large lunar landscape about four feet wide and ten feet long, in black and white, showing the earth in the sky. We shall expect Mr. Butler to make a much finer one and in natural colors. Another exhibit represented the sun as a star with fifteen or twenty of its nearest neighbors, all shown in relative *sizes, colors, distances* and *directions,* by small balls suspended by fine wires. The balls were red, yellow and white. The sun, being a yellow star, was represented by a yellow ball. Double stars were shown by two balls.

In this collection is a Ptolemaic planetarium in a spherical glass globe about six feet in diameter, with constellations shown on glass sphere—the earth stationary in the center and the sun, moon and the planets known at the time this theory prevailed revolving about the earth, each planet on its epicycle. There is a crank on the outside of the sphere with which visitors may turn the whole apparatus—an excellent mechanism.

In another room is a Copernican Planetarium of the same size, with the constellations on the glass sphere, the sun in the center, with all eight planets with their satellites, all geared properly, revolving around it. A crank on the outside for turning the apparatus completes this excellent mechanism.

The feature of the crank on the outside of these pieces of apparatus, which can be turned by the visitor, adds greatly to his interest and understanding. A similar crank was to be found attached to apparatus for showing the phases of the moon.

In another room is a large Copernican Planetarium, made by the Carl Zeiss Optical Works, without doubt the largest and best in the world. A lighted globe in the center represents the sun. The six planets nearest the sun with their satellites, the planets and satellites all revolving at their proper relative speeds are shown. The diameter of Saturn's orbit is twelve meters. Uranus and Neptune are left out, presumably because their tremendous distances would make the rest so small proportionately. There is no light except from the central sun, and the walls, ceiling and floor are painted black. Consequently day and night are well shown on any of the six planets, and our moon goes through its phases with realistic clearness. For the lecturer or demonstrator, a car travels around under the earth, which goes around the sun in twelve minutes, the apparatus being propelled by an electric motor. A periscope makes it possible to see the phases of Mercury and Venus on the plane of the ecliptic. Constellations of the Zodiac are shown in a belt on the wall, with their names in white letters and with the degrees of the circle marked. The stars are shown by lights back of small, round holes in the black wall.

In one room more than one hundred kinds of sun-dials were exhibited, and on an adjoining terrace the four principal types of sun-dials were set up for actual service out of doors. On clear days these attracted the attention of visitors. On this terrace there were also a sun-chronometer, a Gnomon for determining the middle of the day (noon) and the day of the year, and a glass-covered house containing two meridian-circles and a chronograph.

The evolution of the refracting and the reflecting telescopes is shown in one room, illustrated for the most part by real telescopes. Galileo's original telescope is shown in replica only. However, the original telescope of Simon Marius, with which he saw the

moons of Jupiter in 1610, the same year in which Galileo first saw them, is here. Four original instruments of Tycho Brahe are also in this room.

The new Zeiss Projection Planetarium is the most impressive and consequently the most popular piece of apparatus in the whole astronomical department. The dome is ten meters or a little more than thirty feet in diameter. They have two lecturers, who together give nine demonstrations a day. We attended one of these, at which a part of the audience was made up of a large class of pupils from a parochial school accompanied by two or three sisters. This type of planetarium will be described later when my visit to the Carl Zeiss Optical Works at Jena is discussed.

In the Science Museum at South Kensington, London, is an astronomical department, but not nearly so large or so interesting as that at the German Museum in Munich. However, one should mention two telescopes made and used by Sir William Herschel, as well as a number of other pieces of apparatus used by the Herschels. The first permanent photographic negative ever produced is here. It is a photograph of the 40-foot reflector at Slough and was made in 1839 by Sir John Herschel. A print from it is framed from rungs of the ladder of the mounting of Herschel's 40-foot reflector at Slough.

A complete list was made of the exhibits in the astronomical department of the Science Museum at South Kensington. All the transparencies in this museum were made from negatives made at the Royal Observatory at Greenwich. We have much finer ones made through our big American telescopes.

At Vienna, in the Natural History Museum, I examined the collection of meteorites, which is said to be the finest in the world, and was impressed with the fact that so many of their specimens had fallen in the United States. Our acting director, Mr. Sherwood, informs me that Ward's Natural Science Estalishment was probably instrumental in sending many of these meteorites to Vienna.

PLANETARIUM PROJECTION

The main object of my trip to Europe was to visit the Carl Zeiss Optical Works at Jena and to examine carefully the new projection planetarium made by this firm. The first instrument of this kind was made for the German Museum in Munich and was merely mentioned above. The second is located upon the roof of one of the buildings of the Carl Zeiss Works. The dome is larger than in the first, being sixteen meters or about fifty feet in diameter, and affords seating room for 280 persons, although in the excitement of the first days as many as 600 persons, more than half standing, were packed into this dome, and as many as twelve lectures and demonstrations a day were given. The dome is hemispherical in shape and is white inside, and in the center is an optical projection apparatus which throws on the inside of the dome images of the sun, moon, all the planets which are visible to the naked eye, and the 4,500 fixed stars that are visible to the naked eye, including the Milky Way. These projected images move as the real bodies appear to move in the sky, with the time accelerated due to rotation of parts of the central apparatus, which is so accurately made that it takes care of the precession of the equinoxes. The erratic motions of the planets in the sky as seen by the naked eye from the earth are visualized much more satisfactorily than by the old-fashioned planetarium. In fact, the former types of planetaria are crude indeed in comparison.

The phases of the moon are just as clearly shown, but most impressive of all is the realistic appearance of the fixed stars, including the Milky Way. In the public demonstrations at Jena the audience was sometimes composed largely of school children. Whether the audience was made up of children or of adults when the fixed stars were turned on an involuntary "Ah" swept over the assembly and they were spellbound. It seems that no one is prepared for such a realistic representation, and I was no better prepared than others. In short, I was astonished, overwhelmed. The illusion of the immensity of space is perfect. One feels that he is in the great outdoors under a clear night sky. Due to some subconscious imagination, perhaps—at least for some psychological or physiological reason, this artificial sky seems to possess the deep night blue seen in the real sky, and yet there was no blue color on the inside of the dome and none in the projection apparatus. On being congratulated upon the mechanism, Dr. Ing. W. Bauersfeld, the inventor, admitted that the illusion of the immensity of space and the realistic representation of the fixed stars, including the Milky Way, had exceeded even his expectations. And Dr. A. Villinger, head of the department of astronomy in the Zeiss Works, was an unbeliever until the apparatus was finished and demonstrated. He thought it would be little more than toy until he saw it demonstrated.

By means of a special set of projectors the names of the constellations can be shown in the sky, and with a flashlight showing an arrow-shaped light the lecturer can point out any star, planet or other body in the sky.

During several days spent at the Carl Zeiss Works I was given every facility for examining this new invention, including several private demonstrations, besides the opportunity of attending a number of public demonstrations. For the latter they have five lecturers, young men with technical training who dur-

ing part of their time are otherwise engaged in the Zeiss Works. Full notes were made concerning the apparatus, its installation, its demonstration and its adaptation to our astronomical hall at the American Museum.

In early September eleven of these planetaria had been sold to cities in Germany, and negotiations were in progress with other cities of Europe. Within a few days they expected to close a contract with Vienna. One of the planetaria in the process of building was seen and photographed in Prinzessinen Park in Jena. In this the dome is twenty-five meters, or a little over seventy-five feet in diameter, almost exactly the same diameter as the dome planned for our astronomical hall. In the one at Düsseldorf the dome will be thirty meters or over ninety feet in diameter. For projectional reasons this is considered the maximum limit in size.

Having read an enthusiastic description of the apparatus and on account of the confidence inspired by the fact that it was made by the Carl Zeiss Optical Works at Jena, I approached this investigation with a tendency toward a favorable consideration. Determining, however, to hold this feeling in check and to approach the matter with an open mind, I made the examination with care and thoroughness. As a result I am enthusiastically in favor of securing a Zeiss Projection Planetarium for our new astronomical hall. Judging from the experience at Jena and at Munich I believe it will attract more people to the museum than anything we have ever had here. When it becomes more widely known it is sure to come to America. May the first one come to the American Museum of Natural History!

G. CLYDE FISHER

AMERICAN MUSEUM OF
NATURAL HISTORY

EDWARD FULLER HOLDEN[1]

WHILE on a vacation trip with his family, parents and friends, Edward Fuller Holden was drowned at North Deer Isle, Maine, August 5, 1925. In the tragic death of Dr. Holden the department of mineralogy of the University of Michigan lost a valuable member of its staff and the science of mineralogy an energetic investigator with unusual promise for splendid achievement. Dr. Holden is survived by his widow, Beatrice M. Holden, and three small sons.

Edward Fuller Holden was born at Woonsocket, Rhode Island, August 28, 1901, where his father, Amasa Amidon Holden, was principal of the high school. His mother, Mary Barnes Holden, is a direct descendant of Edward Fuller, of the Mayflower group.

[1] Presented before the Mineralogical Society of America, at New Haven, Conn., December 29, 1925.

Dr. Holden's early training was obtained in the schools of Woonsocket, and of York, Pennsylvania, where the family removed in 1913. After completing the high-school course in the latter city, Dr. Holden entered the Pennsylvania State College in January, 1918, where he enrolled as a student of mining engineering. His unbounded energy and exceptional ability as a student permitted him to complete the high school and college courses in seven years. He received the degree of bachelor of science from the Pennsylvania State College in 1921. His advanced degrees were conferred by the University of Michigan, the degree of master of science in 1923 and that of doctor of philosophy in 1925.

At an early age Dr. Holden evidenced great interest in minerals, which was stimulated by a course in general science pursued in the eighth grade. Throughout his high-school course this enthusiasm developed to such an extent that before entering college he submitted for publication in the *American Mineralogist* a short paper on the occurrence of quartz crystals. As an undergraduate student Dr. Holden decided upon a career in mineralogy and accordingly chose his studies with that goal in view. His ability as an investigator now began to manifest itself and by the time he received the baccalaureate degree he had prepared six papers on mineralogical topics which appeared in the *American Mineralogist*. From the autumn of 1921 until his death Dr. Holden held the position of instructor in mineralogy and during this period earned his graduate degrees.

While a student at the Pennsylvania State College Dr. Holden became interested in the cause of color in minerals, and to this problem he devoted much of his time at the University of Michigan, making notable contributions to its solution. His papers on the cause of color in rose quartz, smoky quartz and amethyst established a new standard for publications in this field. Dr. Holden's thorough training in the various phases of mineralogy and in chemistry and physics permitted him to approach this problem from several standpoints, as had not been the case with many of the earlier investigators of this subject. His paper on the pigmentation of amethyst was awarded the Walker prize for 1925 by the Boston Society of Natural History and was adjudged as being of unusual merit. Had Dr. Holden been spared to continue his researches he would have undoubtedly contributed much toward clarifying the perplexing problem of the cause of color in minerals. At the time of his death Dr. Holden had published sixteen papers and in addition had collaborated with me in the preparation of a text-book on "Gems and Gem Materials," which was published shortly after his death.

In 1921 Dr. Holden began abstracting papers on

mineralogical and geological subjects for *Chemical Abstracts* and in 1922 became associate editor of that division of the journal. He also contributed numerous abstracts to the *American Mineralogist* and the *Revue de Géologie*. In all he prepared over twelve hundred abstracts for these publications, in addition to several book reviews. In 1923 he was also appointed associate editor of the *American Mineralogist*.

Dr. Holden attended the organization meeting of the Mineralogical Society of America in December, 1919, and became a charter member. In 1922 he was elected to fellowship in the society. He was also a fellow of the American Association for the Advancement of Science and a member of the Michigan Academy of Science and of the Junior Research Club of the University of Michigan. He also held membership in the Tau Beta Pi, Phi Kappa Phi and Sigma Xi societies.

The intense scholarly activity and splendid scientific achievement of this short life of twenty-four years will remain an exceptional record in the history of American mineralogy.

EDWARD H. KRAUS

MINERALOGICAL LABORATORY,
UNIVERSITY OF MICHIGAN

SCIENTIFIC EVENTS

THE MERGER OF THE ARMOUR INSTITUTE OF TECHNOLOGY WITH NORTHWESTERN UNIVERSITY

FORMAL steps toward the merger of Armour Institute of Technology with Northwestern University were taken on January 9, when the trustees of the two institutions signed contracts detailing the affiliation plan.

The plan includes the raising of a $10,000,000 endowment fund; erection on Northwestern University's Evanston campus of 10 new dormitories for men at an estimated cost of $80,000 each; expansion to three times its size of the Swift hall of engineering at Northwestern; construction of one addition to machinery hall; construction of two new science buildings and the erection of one machinery hall on Northwestern's downtown campus to accommodate between 800 to 1,000 part-time students.

The new engineering school will be known as the Armour College of Engineering of Northwestern University. The retention of the Armour name is in memory of Philip D. Armour, whose initial contribution of $1,000,000 in 1893 founded the Armour Institute.

The plan assumes that the Chicago Art Institute will continue to house the Armour School of Architecture. Pointing to the need for a great college of engineering and architecture, Dr. Howard M. Raymond, president of the Armour Institute of Technology, said:

> It seems justly logical that a union with Northwestern University should result in a greater educational efficiency and an ability for public service such as could never be attained by either as they exist to-day.

President Walter Dill Scott, of Northwestern University, said:

> Chicago's motto is "I will." The men behind this fine plan are among the leaders of this great center. They represent that spirit. I think that answers the question—can this worthy thing be done?

The fast-growing population of the Mississippi Valley is causing constant expansion and enlargement of the facilities for supplying electricity, gas, street cars and related utilities. With the existing limited facilities for training engineers, competent ones can not be graduated rapidly enough to meet the demand.

Mr. Insull visualizes for Chicago the finest school of engineering in the middle west, if not in the country. He is a man of foresight and his cordial endorsement of our plans has encouraged Armour Institute and Northwestern to approach the merger with greater confidence.

THE NEW YORK ZOOLOGICAL SOCIETY

THE executive committee of the New York Zoological Society has submitted a report to the board of managers covering the period June 20, 1925, to October 15, 1925:

On January 29, 1925, the appropriation for the alteration of the aquarium became available and contracts amounting to $33,818 have been awarded and work has been commenced. The contracts call for the completion of the interior and for a coat of stucco on the exterior, but the appropriation is insufficient to provide for a parapet on top of the wall, which is much needed for the appearance of the building and must be added later.

On July 31, an appropriation of $24,000 became available for the substitution of a copper roof for the present polychrome tiles on the dome and flat roofs of the elephant house. Contracts will be shortly awarded, but the work can not be commenced until early next spring. An appropriation of $32,000 was made for much needed improvements and repairs at the park. This work is now under way. The chief repairs consist of: Repairs to the smaller buildings, reconstruction of the blacksmith shop, new boundary fence, replacement of wornout water lines and repaving the Concourse.

On September 30, the balance to the credit of the several funds of the society amounted to $66,681.80.

The attendance at the park from June 15, 1925, to October 16, 1925, was 1,171,457, while the attend-

ance at the aquarium for the same length of time was 804,397.

The July *Bulletin,* which was devoted to the *Arcturus* expedition, has been issued. Zoologica, Volume 4, Numbers 3 and 4; and Volume 6, Numbers 4 and 5, have been issued; also the index for Zoologica, Volume 3.

On the 30th day of July the steamer *Arcturus* returned from a voyage to the Sargasso Sea and the Humboldt Current off the Galapagos Islands. Mr. William Beebe found that the former had been scattered by storms, so the *Arcturus* passed through the Panama Canal to the region of the Galapagos. The expedition reached there at a most opportune moment, as the Humboldt Current had been deflected by unknown causes, with the result that marine life was greatly disturbed and a unique opportunity was afforded for observation. The *Arcturus* found volcanos in active operation, pouring lava into the sea and destroying marine life. The total cost of the expedition will be upwards of $184,000, of which Mr. Harrison Williams will have given a total of $140,476.

Dr. Raymond L. Ditmars left New York on August 15, 1925, on a scientific mission to Brazil. It has been through extractions of snake venoms made by Dr. Ditmars and sent to the Instituto Soro Therapico, at Sao Paulo, that anti-venines specific for the bites of North American poisonous serpents have been supplied to this country. The Brazilian authorities were in need of sufficient venom to carry on the production of the characteristic serums for the United States. Dr. Ditmars took with him a fluid gallon of rattlesnake venom—the largest amount that has ever been provided for laboratory purposes—and was assured by Dr. Vital Brazil, at Sao Paulo, that this amount would be sufficient to last for approximately thirty years of immunization work. Dr. Ditmars returned with a quantity of the most powerful serum ever prepared for the United States, a fine series of living Brazilian reptiles, and materials for articles for the society's publications.

The need of an endowment fund is pressing and the executive committee has appointed a committee of Messrs. Irving K. Taylor, Henry D. Whiton, Bayard Dominick, Henry F. Osborn, Jr., and Madison Grant, ex-officio, to undertake a campaign to raise $1,500,000 for the general endowment of the society. Towards this sum the conditional subscriptions of $500,000 of John D. Rockefeller, Jr., and $100,000 of Edward S. Harkness are available, leaving $900,000 to be raised. The members of the board of managers are requested to cooperate with this committee.

THE JAMES SIMPSON-ROOSEVELT EXPEDITION OF THE FIELD MUSEUM

THEODORE AND KERMIT ROOSEVELT, leading the James Simpson-Roosevelt expedition into central Asia for the Field Museum, have not only obtained eight of the rare Ovis Poli (Marco Polo sheep) but have secured the finest representative collection of big game ever taken in the western Himalayas, the Pamirs and Chinese Turkestan, according to an announcement made by D. C. Davies, director of the museum, following the receipt of letters from Col. Theodore Roosevelt to James Simpson, who is financing the expedition, and to Stanley Field, president of the institution.

"We got four male Poli, two young males, a female and a young animal," wrote Col. Roosevelt. "Out of this assortment the museum can get the finest and, so far as I know, the only group of Poli in the world." Forty-four large animals were secured during what Col. Roosevelt calls "the big trek through Turkestan, the Tien Shan and the Himalayas." The specimens include eleven Tien Shan Ibex and three Ovis Karelini, or Tien Shan sheep. Of this game Col. Roosevelt says: "We have for the museum two record heads, an Ibex and a Karelini, both of which fell to Kermit's rifle. I was fortunate enough to get the largest Ovis Poli."

After leaving the Russian Pamirs, the Roosevelts went to Srinagar, Kashmir, where they were met by their wives, who will remain in India until the second leg of the expedition into the central provinces of India and into Nepal is carried out. The hunters are now on the trail of the famous "armor-plated" rhinoceros and royal Bengal tiger, as well as other large game, including the leopard, wild boar and Indian deer. They are receiving assistance from Indian and British officials and are being permitted to hunt in protected areas for the rare beasts.

According to Col. Roosevelt's letter the expedition will leave the field about January 20 and return to the United States in February.

THE NORTON BRONZE TABLET AT CORNELL COLLEGE

THERE was recently unveiled at Cornell College, Iowa, a bronze tablet commemorating the fiftieth anniversary of Dr. William Harmon Norton's occupancy of the chair of geology. Unveiling of the tablet took place immediately after the dedicatory exercises of the Law Memorial Hall, the new home of the geological and biological departments of the college, and as a part of the proceedings. The erection of the building dedicated to the service of geology was made possible through the munificence of Reverend Doctor Marion Law, of Narragansett, Rhode Island.

The program began with the singing of an appropriate anthem by the college choir, under the leadership of Professor E. H. F. Weis. Dr. Law then made a brief presentation address; and the acceptance of the gift was acknowledged by the Hon. W. R. Boyd, of the Iowa State Board of Education. The formal address was delivered by Professor William Morris Davis, of Harvard University, who took as his subject "The Faith of Reverent Science." Before the memorial hall Rev. J. E. Johnson, president of the board of trustees, gave the dedicatory address and offered prayer. On behalf of the Iowa colleges greetings were extended by Professor G. F. Kay, of the Iowa State University.

The ceremony of the unveiling of the bronze tablet in honor of Professor Norton, who served with distinction for fifty years on the faculty of Cornell College, took place in the geological auditorium, Dr. Howard E. Simpson, professor of geography in the State University of North Dakota, and an old student and colleague of Professor Norton, delivering the principal address. He said in part:

> Fifty years ago, William Harmon Norton, a youthful graduate, dedicated his life to the service of Cornell College, his Alma Mater. For these fifty years he has served the young manhood and young womanhood of America from this hilltop. To-day we are gathered to dedicate a hall of learning in which his master science, geology, will be taught—a hall made both necessary and possible by his teaching. In it will be housed the department which he has created, the head chair and the departmental library of which he has endowed, and the laboratory collections which have been largely gathered by his own hands.
>
> It is most fitting, then, that after dedicating this beautiful and useful building to the teaching of that most noble science, geology, we pause here briefly to unveil a tablet of enduring bronze, so placed that all who pass within the portals of this hall may read our tribute to the man we first learned to love, honor and respect as a teacher.

SCIENTIFIC NOTES AND NEWS

PROFESSOR ALBERT EINSTEIN has been awarded the gold medal of the Royal Astronomical Society.

PROFESSOR J. W. MCBAIN, Leverhulme professor of physical chemistry in the University of Bristol, will deliver a course of lectures on colloid chemistry at the University of California during the first part of this year and he will be the guest of honor at the National Colloid Symposium to be held in June at the Massachusetts Institute of Technology.

SIR ROBERT JONES, orthopedic surgeon, president of the Association of Surgeons of Great Britain, has been made a baronet. Other names on the king's new year list of honors include the following who have been knighted: Thomas Hudson Beare, Regius professor of engineering and dean of the faculty of science at the University of Edinburgh; Dr. Albert Alfred Bolam, chairman of the council of the British Medical Association, and Professor John Bretland Farmer, governor of the Imperial College of Tropical Agriculture, Trinidad.

EDWARD DEAN ADAMS, of New York City, has been awarded the John Fritz gold medal for engineering achievement by the Engineering Foundation.

THE presentation of the Perkin medal of the Society of Chemical Industry to Dr. R. B. Moore took place at the Chemists Club, New York, on January 15. Addresses were made by Dr. S. C. Lind, of the U. S. Bureau of Mines, and Dr. Herman Schlundt, of the University of Missouri.

PROFESSOR B. S. KITASATO, director of the Royal Japanese Institute for Infectious Diseases, has been awarded the Harben gold medal for 1925 of the Royal Institute of Public Health, England.

DR. CH. HEDON, professor of physiology at the University of Montpellier, and Dr. E. Laguesse, professor of histology at the University of Lille, have been awarded the Prince Albert of Monaco prize of the French Academy of Medicine. This prize has a value of 100,000 francs.

M. J. BETHENOD, of the École Supérieure d'Electricité, Paris, has been awarded the Gaston Planté prize by the French Academy of Sciences for his work on the generation and utilization of alternating current at high frequencies.

ALBERT CAMPBELL, formerly of the National Physical Laboratory, has been awarded the Duddell medal of the Physical Society of London.

PROFESSOR JOHN S. PLASKETT, director of the Dominion Astrophysical Observatory, Victoria, B. C., received the honorary degree of LL.D. at the recent convocation of the University of British Columbia, the first to be held in the permanent buildings of the university at Point Grey.

DR. HIDEYO NOGUCHI was given a complimentary dinner at the University Club, New York, on January 15, by the trustees, scientific directors, members and associate members of the Rockefeller Institute for Medical Research.

JAMES E. DAVIDSON, president of the National Electric Light Association, was the guest of honor at a dinner given on December 30 by the Nebraska Section of that association, at the Hotel Fontenelle, Omaha.

IT was stated in the issue of SCIENCE for January 1 that a building at the University of Wisconsin had been named in honor of Professor Stephen E. Babcock. We are informed that this is an error. The Mining Engineering Building at the University of North Dakota has been named in memory of the late Earl J. Babcock, former dean of the College of Engineering, whose death was recorded in the issue of SCIENCE for October 13, 1925.

DR. GEORGE K. BURGESS, of the U. S. Bureau of Standards, has been elected president of the Washington Academy of Sciences for the ensuing year. Drs. W. W. Campbell and Raymond Pearl were elected non-resident vice-presidents.

THE Society of American Bacteriologists has elected officers for 1926 as follows: *President,* Hans Zinsser, Harvard Medical School; *Vice-president,* Robert S. Breed, Agricultural Experiment Station, New York; *Secretary-treasurer,* James M. Sherman, Cornell University; *Councilors,* S. Henry Ayers, C. C. Bass, F. M. Huntoon, and Karl F. Meyer.

DR. RUSH MCNAIR has been elected head of the Kalamazoo Academy of Medicine to succeed Dr. S. Rudolph Light.

DR. JOHN B. WATSON has been succeeded in the editorship of the *Journal of Experimental Psychology* by Professor Madison Bentley, University of Illinois. The journal belongs to the group of Psychological Review publications now owned and published by the American Psychological Association.

WALTER G. WHITMAN, assistant professor of chemical engineering and assistant director of the research laboratory of applied chemistry at the Massachusetts Institute of Technology, has joined the research staff of the Standard Oil Company.

T. S. LOVERING has been appointed junior scientist in the U. S. Geological Survey.

DR. MYNIE G. PETERMAN, associate in pediatrics, Mayo Clinic, Rochester, Minnesota, has accepted the position of director of laboratory and research at the Children's Hospital, Milwaukee.

DR. GEORGE GRANT MACCURDY, of Yale University, director of the American School of Prehistoric Research, has been designated by the school and the Smithsonian Institution to represent them at the Archeological Congress to be held in Palestine and Syria from April 2 to 23.

PROFESSOR G. W. MUSGRAVE, head of the department of agronomy at Rutgers University, has been granted a leave of absence to organize and direct the new agricultural department of the American Cyanamid Company.

LUDLOW GRISCOM, assistant curator of birds at the American Museum of Natural History, sailed from New Orleans on January 9 as the museum representative on the Mason-Spinden Ornithological Expedition to the east coast of Yucatan. He will pay special attention to the bird life of this little-known coast and will endeavor to secure representative collections of the peculiar species of birds known only on Cozumel Island.

MAJOR E. A. GOLDMAN, of the U. S. Biological Survey, has gone to Mexico, where he will spend about three months investigating the principal wintering areas of migratory wild fowl at widely separated points in that country.

DR. S. F. BLAKE, of the U. S. Bureau of Plant Industry, accompanied by his wife, Mrs. Doris H. Blake, of the U. S. Bureau of Entomology, recently returned to Washington after spending several months abroad in scientific work while on leave from their respective offices.

DR. BRADLEY M. PATTEN, associate professor of histology and embryology in the school of medicine of Western Reserve University, has returned to Cleveland after two months spent in Baltimore studying the collection of young mammalian embryos at the Carnegie Embryological Institute.

DR. DAVID CHEEVER, professor of surgery in the Harvard Medical School, has been given a sabbatical leave of absence for the second half of the school year. He will devote this time to rest and travel, going first to California.

DR. EDWIN BIDWELL WILSON, professor of vital statistics in the School of Public Health at Harvard University, will deliver the fifth Harvey Society lecture at the New York Academy of Medicine on Saturday evening, February 6, at eight-thirty. His subject will be "Empiricism and Rationalism."

IN MARCH DR. GEORGE H. PARKER, of Harvard University, will give at the Wagner Free Institute of Science of Philadelphia four lectures on "The Animal Mind: its Source and Evolution."

DR. CHARLES H. MAYO, of the Mayo Clinic, Rochester, will give a lecture before the Franklin Institute on January 28, on "Light and Health."

DR. L. O. HOWARD, chief of the Bureau of Entomology of the United States Department of Agriculture, addressed the Science Club of the Kansas State Agricultural College on January 4 on the subject "The Biological Control of Insects."

DR. H. V. HARLAN, of the Bureau of Plant Industry, U. S. Department of Agriculture, recently delivered an address before the Royal Canadian Insti-

tute on the subject "Experiences of a Plant Explorer in Abyssinia."

DR. MARTIN H. FISCHER, Eichberg professor of physiology at the University of Cincinnati College of Medicine, lectured at the Mayo Foundation, Rochester, on December 7, 1925, on "Colloid Chemistry in Biology and Medicine."

DR. FRANCIS C. WOOD, director of the Crocker Cancer Research Institute, Columbia University, addressed the Wayne County Medical Society, Detroit, on January 22, and gave a clinic at the Harper Hospital in the morning.

DR. JAMES E. ACKERT, professor of zoology at the Kansas State Agricultural College, lectured on January 7 and 8 at Ottawa and Baker Universities (Kansas), on the subject, "Contributions of Medical Zoology to Human Welfare."

DR. WILLIAM W. FORD, professor of bacteriology at the Johns Hopkins School of Hygiene and Public Health, has been appointed to prepare the official report to the state department of health of the life of Dr. Raymond C. Salter, chief of the bureau of bacteriology, who died recently.

IN memory of the late Professor Bergonié, it has been decided to found in Bordeaux a laboratory for electrical and radiological research, with possibly the creation of a fund to give grants to research workers and to assist radiologists suffering from the effects of radium and X-rays.

DR. WILLIAM E. SAFFORD, economic botanist for the United States Department of Agriculture, died on January 10 at the age of sixty-six years.

C. N. CATLIN, associate professor of agricultural chemistry at the University of Arizona, died on November 12, following an operation for appendicitis.

DR. FREDERICK T. ASCHMAN, chemist for the Pennsylvania State Food Department and formerly professor of chemistry in the school of pharmacy at the University of Pittsburgh, died on December 10, aged sixty-eight years.

DR. MARTIN MURPHY, consulting engineer, past president of the Nova Scotia Institute of Science and of the Canadian Society of Civil Engineers, died on January 9, aged ninety-three years.

DR. JOHN GRAY MCKENDRICK, from 1876 to 1906 professor of physiology in the University of Glasgow and later Foulerton professor of physiology at the Royal Institution of Great Britain, died on January 2, aged eighty-five years.

DR. U. N. OUSSIMENKO, deputy territorial veterinarian and bacteriologist for the Island of Maui, in Hawaiian Territory, died on January 13 of anthrax. Dr. Oussimenko had been experimenting with anthrax in his laboratory.

DR. ERNEST DESNOS, member of the French Academy of Medicine, recently died in Pondicherry, India, from cholera. Dr. Desnos went to India several months ago to make a special study of the disease from which he died.

THE death is announced from Berlin, at the age of fifty-five years, of Professor Georg Klingenberg, a well-known German electrical engineer.

THE International Institute for Intellectual Cooperation was inaugurated in Paris on January 16, in the rooms of the old Palais Royal. Gilbert Murray, Madame Curie, Albert Einstein, Professor R. A. Millikan and many other prominent scientific men attended.

THERE was recently organized at Honolulu the Hawaiian Academy of Science with a charter membership of 80. The officers are: Dr. F. C. Newcombe, *President;* Dr. C. Montague Cooke, *Vice-president;* E. L. Caum, *Secretary-treasurer;* Otto H. Swezey and Professor F. G. Krauss, members of the executive committee.

THE Chicago section of the American Institute of Chemical Engineers has elected the following officers for 1926: *Chairman,* F. M. de Beers; *Vice-chairman,* W. B. Brown; *Secretary-treasurer,* B. B. Freud.

THE annual meeting of the Northeastern Bird Banding Association was held on January 15 in the lecture hall of the Boston Society of Natural History.

THE nineteen members of the Sigma Xi connected with the faculty of the State College of Washington recently organized a Sigma Xi club. On January 7 the group met at dinner to hear the reports of two of its members, Dr. H. E. Culver and Professor F. J. Sievers, who attended the meeting of the national society at Kansas City.

A SIGMA XI CLUB of Rochester was organized on December 2, 1925, composed of the members of the Society of Sigma Xi in Rochester and vicinity. Professor Liberty Hyde Bailey, of Ithaca, newly elected president of the American Association for the Advancement of Science for 1927, gave an address, cautioning his hearers against pre-judgment, or prejudice, in all activities. The truth should be sought and it alone control our affairs. Professor Fairchild acted as temporary chairman until Professor John R. Murlin, of the department of vital economics of the University of Rochester, was elected. Of the 32 present, 17 are connected with the Univer-

sity of Rochester and 11 with the research laboratories of the Eastman Kodak Company.

PLANS for the midwinter New York convention of the American Institute of Electrical Engineers, which will be held in the Engineering Societies Building on February 8 to 11 inclusive, are about complete. The wide range of subjects includes transmission stability, protective and control systems, bus and structural construction, electrical machinery, measurements, insulation and dielectric absorption, electromagnetism and electrophysics, communication and sound reproduction and furnace-resistor design. On February 10, there will be a dinner-dance at the Hotel Astor, and on Thursday evening an address by a prominent speaker not yet selected.

THREE lectures under the John Howard Appleton Fund have been arranged by Brown University for this season. The first lecture was given on January 21, by Dr. Colin Fink, professor of electro-chemistry at Columbia University, whose subject was "The Electrolytic Restoration of Ancient Bronzes." Dr. Glenn E. Matthews, photographic chemist in the research laboratory of the Eastman Kodak Company, will give the second lecture, "Color Photography," on Thursday, February 11, and Dr. Gustavus J. Esselen, Jr., of Boston, the third lecture, "The Modern Advancement of Cellulose in Industry," on March 18.

THE New York Aquarium announces that the series of radio talks given from Station WEAF on alternate Fridays since June, 1925, by Miss Ida M. Mellen, assistant to the director of the aquarium, will be repeated during 1926 in response to numerous requests. This time Miss Mellen will be heard on occasional Wednesday evenings in the New York Zoological Society series, Station WJZ, beginning with two talks in February—one on "The New York Aquarium and its Denizens" and one on "Goldfishes and the Care of Fishes in Captivity." These will be followed by ten other talks on fishes, succeeding subjects being Whales and Porpoises, Sea Birds at the Aquarium, Seals and Sea Cows, etc.

A SERIES of twelve semi-popular radio lectures on the birds of Iowa will be broadcast from WSUI, the University of Iowa broadcasting station, by Professor Dayton Stoner beginning February 8 at 7:50 P. M. The series is to be continued weekly until finished. This is one of the radio correspondence courses offered during the coming semester by the extension division of the university.

DURING the past few months, Dr. H. H. Sheldon, of the department of physics at New York University, has been giving half-hour radio talks through Station WJZ, of the Radio Corporation of America. He spoke on the following subjects: Molecules and atoms; The electron and the vacuum tube; Inside the atom; The nature of sound and light; The X-ray; Ultra-violet and polarized light; Light and color; Heat and temperature; Resonance and radio reception; The nature of energy.

THE board of governors of the Mayo Clinic has established the J. William White scholarship. This scholarship has been made possible by reason of a legacy left to Dr. W. J. Mayo and Dr. C. H. Mayo by the late Dr. White, formerly professor of surgery at the University of Pennsylvania. It was Dr. White's desire that the proceeds from this gift should be used for educational purposes in the Mayo Foundation. In accordance with this wish the board of governors has decided that a scholarship should be created, the scholarship to be awarded by the trustees of the Mayo Properties Association, on the recommendation of the medical graduate committee of the Mayo Foundation, to the graduate (either M.S. or Ph.D. in surgery in the Mayo Foundation) who, in the opinion of the committee, is most deserving of an opportunity for study in surgical clinics in foreign countries.

IT was recently announced in SCIENCE that Dr. J. B. Whitehead, of the Johns Hopkins University, had been awarded the triennial prize for 1925 of the Fondation George Montéfiore of Liège. We learn from *Nature* that this prize was divided and awarded to four engineers as follows: To Mr. F. Creedy, electrical and mechanical engineer, London, for papers on "Some Developments in Multi-speed Cascade Induction Motors" and "Variable Speed Alternating Current Motors without Commutators" (6,000 francs); Professor J. B. Whitehead (4,000 francs); Mr. Checholowsky, electrical engineer, Antwerp, for his "Study on Operating and Releasing Times of Telephone Relays" (4,000 francs), and a prize (2,000 francs) for the description of "A New Form of Converter" was awarded to Mr. Raymond Wilmotte, London.

REPRESENTATIVE ROBINSON, of Ittawamba, introduced a bill in the Mississippi legislature on January 6 to prohibit the teaching of the theory of evolution in schools and colleges of Mississippi supported in whole or in part by state appropriation. The bill is almost a replica of the Tennessee law and provides a fine of from $100 to $500 for violation.

WE learn from *Nature* of the award of prizes by the Anthropological Society of Paris. The Godard prize for 1924 is awarded to Dr. Maurice Neveux for a thesis entitled "Religion des Noirs: Fétiches de la Côte d'Ivoire," which embodies observations made when the author was in charge of the medical services of that area. Two awards of the Brocas prize are

made. The prize for 1922 is awarded to Dr. Fritz Sarasin, of Basle, for his work on the anthropology of the New Caledonians, and to Dr. E. Pittard, of the University of Geneva, for his book on the peoples of the Balkans. The prize for 1924 was divided between Dr. Antoine Delattre for a thesis on the comparative anatomy of the axis in mammals; M. Chaine, of Bordeaux, for his work on the digastric muscle, and M. Cipriano Lidio, of Florence, on the human patella.

THE Wagner Free Institute of Science of Philadelphia is about to begin the publication of a quarterly bulletin to contain reports of research conducted under its auspices and also information in regard to its educational activities. Volume II of its Transactions is now in press containing a paper on "The Chemistry and Physiology of the American Pitcher Plants," by Dr. Joseph S. Hepburn.

THE University of Washington is to be an international center of the United States and Canadian fisheries research work on the Pacific Coast, according to announcement from Dean John N. Cobb, of the College of Fisheries. The International Fisheries Commission, composed of official state fisheries commissions of Pacific coast states, Alaska and British Columbia, together with the entire Canadian department of fisheries, will consolidate all work here. The university was selected especially because of its proximity to the halibut and salmon supply. Eight leading fisheries scientists will locate in Seattle, among them William S. Thompson, of the California state fisheries, and Dr. H. F. Rich, of Washington, D. C.

AN increase of the endowment of the American Museum of Natural History of New York City by $10,000,000 was urged by its president, Dr. Henry Fairfield Osborn, in his annual financial administrative report made to the board of trustees. While gifts for exploration and other special purposes reached the record amount of $400,000 in 1925, according to Dr. Osborn, additional funds are needed to enable the museum to resume work now suspended and carry on its normal expansion. Operating and administrative costs of the museum, he said, have risen 120 per cent. in the last decade without a corresponding increase in the endowment or the city's annual appropriation.

UNIVERSITY AND EDUCATIONAL NOTES

ABOUT $6,000,000 will ultimately be given to charitable and educational institutions under the will of the late Dr. Norman Bridge. The estate, on the death of the widow, is to be divided equally between the University of Chicago for medical education, the University of Southern California Medical Department, the Barlow Sanatorium Association of Los Angeles, the Southwest Museum Incorporated, Los Angeles, and La Vina, a sanatorium in Pasadena; each of the five institutions, it is reported, will receive about $1,200,000. There were ten $10,000 bequests also, among others to Northwestern University and the University of California.

PRINCETON UNIVERSITY has received a gift of $150,000 from Thomas D. Jones, of Chicago, to be used to endow a chair in the department of mathematics to be called the Henry Burchard Fine professorship of mathematics in honor of Professor Fine, dean of the department of science.

A RECENT gift to Yale University made by Mrs. Knight, widow of Dr. George H. Knight, completes the amount necessary for meeting the terms of the General Education Board contingent pledge of $1,000,000 endowment for the school of medicine.

DR. ALBERT W. GILES, professor of geology at the University of Virginia and former state geologist of Virginia, has been appointed head of the department of geology at the University of Arkansas.

DR. OAKES AMES, assistant professor of economic botany at Harvard University, has been promoted to professor of botany in the university.

DR. ALBERT O. HAYES, of Ottawa, Canada, has been appointed visiting professor for the second term at Lafayette College to fill the vacancy in the department of geology, created by the death of the late Professor Peck.

DR. PAUL B. MACCREADY, formerly a fellow in medicine of the National Research Council, has recently been appointed as clinical instructor of surgery at Yale University Medical School.

PROFESSOR A. V. HILL, who recently resigned from the Jodrell chair of physiology at University College, London, to accept an appointment by the Royal Society to a Foulerton chair, will continue his work at the University of London and will hold the title of professor of physiology.

ASSOCIATE PROFESSOR F. J. TEAGO, of the University of Liverpool, has been appointed to the Robert Rankin chair of electrical machinery in the university.

DISCUSSION AND CORRESPONDENCE

A NOTE ON THE HUMBOLDT CURRENT AND THE SARGASSO SEA

As I have already reported unofficially, when I visited the Galapagos during the early months of 1925, in the New York Zoological Society's oceanographic vessel *Arcturus*, I found the Humboldt Cur-

rent so weakened in movement and negligible in temperature that it was practically absent for many miles in all directions about the Archipelago. When I returned to Panama I learned that similar reports had been made by masters of vessels coming up the western coast of South America, the defection of the current being detected as far south as Central Chili. I have just received a detailed account of the visit of an American cruiser to the Galapagos during September, 1925. The commander reports the Humboldt Current as apparently normal again, its effects being first noticeable as far west as the Marquesas, a remarkable extension of the recorded range of this current.

The volcano on Albemarle, whose eruption coincided with the visit of my *Arcturus*, was found at the time of the cruiser's visit to be still in full activity, and several aerial photographs were obtained of the lava flowing into the sea.

A Note concerning the Sargasso Sea: My sole object in visiting this interesting area was to carry on extensive trawling directly beneath any large masses of the weed which I might encounter. I have seen two to four acres of thickly matted weed in other years, and thought that beneath such an assemblage there might be an unusual abundance of mid-depth life—in two to five hundred fathoms—attracted and nourished by the continual supply of food in the shape of a host of individual organisms which are forever dying and dropping down from the weed. Owing to a steady series of severe storms throughout at least one half of the Sargasso Sea, I saw almost no lot of weed larger than a man's head, and hence was compelled to give up my primary object and steam for the Panama Canal.

WILLIAM BEEBE

DIRECTOR OF TROPICAL RESEARCH,
NEW YORK ZOOLOGICAL SOCIETY

AN INVESTIGATION OF THE PERIODIC FLUCTUATIONS IN THE NUMBERS OF THE RUFFED GROUSE

THE periodic cycles of scarcity and abundance in the ruffed grouse have been a source of much speculation among generations of American sportsmen, but in spite of the very great interest in the subject, especially of late years, there has been no serious scientific attempt to unravel the problem, which biologically is most interesting, perhaps even fundamental. We know of similar cycles in many northern mammals, especially among mice and the northern hare. We know, too, that these depression cycles of our grouse are more marked in the primitive backwoods of our northern states and Canada than they are in the settled or partly settled farm regions, but we do not know the reason for this. Various parasites, some at least of a harmless nature, have been described, and several diseases have recently been discovered,[1] but we know almost nothing of their relative significance or their interplay. Least of all do we know the life history and diseases of the young growing broods up to six or eight weeks of age.

A depression cycle which started very abruptly after an apparently successful breeding season in 1924 caused much comment and resulted in the formation of a grouse investigation committee at the annual meeting of the American Game Protective Association in New York in December of that year. This was stimulated by the work of Dr. A. A. Allen, of Cornell University, who had reported the presence of a minute worm called Dyspharynx in the proventriculus of many wild birds and also in captive specimens. In the meantime, Dr. A. O. Gross, of Bowdoin College, had planned a rather detailed study of the life history of the bird and had begun to assemble material.

October last saw the formation of a subsidiary committee, of which the writer is chairman, sponsored by the Massachusetts Fish and Game Protective Association, which is devoting itself more especially to the field of New England and hopes to raise a fund of $10,000 to carry on its work for at least several years. The Department of Comparative Pathology, of the Harvard Medical School, under Dr. E. E. Tyzzer, has agreed to take over the investigation of diseases, while Dr. Gross will devote himself to the more general problems and intimate studies of the life history of the species. Our New England committee will act in cooperation with the central committee in New York, who with Dr. A. A. Allen will operate especially in New York, Pennsylvania and bordering states.

Progress has already been made, especially in giving publicity to our need for specimens of both healthy and diseased birds. A most successful point of attack has been opened up through the use of the radio in securing cooperation of interested persons in widely scattered parts of New England and Canada. For this we have to thank Mr. Thornton W. Burgess, of Springfield, who, through the Westinghouse Station (WBZ) has appealed to the many thousand members of his Radio Nature League. So far as I am aware this is one of the first attempts to utilize the radio in a direct attack on a scientific problem. Mr. Austin H. Clark, of the Smithsonian Institution, deserves great credit in suggesting the possibilities of this new method of securing information. The great possibilities of the radio seem already proved if one may judge

[1] See *Auk*, 1925, p. 423, and SCIENCE, 1925, Vol. LXII, p. 55.

by the steady inflow of specimens, besides important data on the local status of ruffed grouse over a wide area.

For the present, fresh New England material in the form of diseased birds, which may be picked up, or healthy birds, which are shot or found accidentally killed, should be sent to Dr. A. O. Gross, Bowdoin College, Brunswick, Maine. Material from other states should be sent to Dr. A. A. Allen, of Cornell University, Ithaca, New York. Collections of crops and viscera carefully labelled and preserved in 10 per cent. formaldehyde are always valuable, as intensive studies of food habits in different parts of the country are well worth making. Contributions are greatly needed and should be sent either to the Grouse Committee of the American Game Protective Association, Woolworth Building, New York City, or to the New England Grouse Fund, Massachusetts Fish and Game Protective Association, 3 Joy Street, Boston.

J. C. PHILLIPS, *Chairman*
Committee on the Ruffed Grouse Investigation for New England
WENHAM, MASSACHUSETTS

GONIONEMUS

FOR many years investigators at Woods Hole have hoped to see the missing stages in the life history of Gonionemus filled in. Dr. L. Murbach and the writer spent many seasons at Woods Hole in an effort to solve the riddle. I have visited the famous Eel Pond at every season of the year, and have been unable to find a single polyp in the early spring. Late in April or early in May great numbers of tiny medusae appeared, but I was quite unable to discover their source or to rear the larvae long enough in laboratory aquaria to get them through their critical period.

In the light of Dr. Joseph's discoveries it is highly interesting to see how close we came to solving the problem on this side of the Atlantic. In one of my early papers on the "Life History of Gonionemus"[1] I figured polyps which I had reared from eggs on microscopic slides, in which there seemed to be a sort of basal budding going on. Only a few such individuals were seen, and they were looked upon as abnormal or as indicating a peculiar method of asexual multiplication.

At the other end of the hiatus in addition to the multitudes of little medusae with twelve tentacles in three different sizes according to age, a single medusa has been reported which was probably Gonionemus, and which appeared in a salt water aquarium. I was summoned in the middle of the winter by Professor George H. Hudson, of the Plattsburg Normal School, to examine a tiny medusa which had appeared in his laboratory aquarium. I think I am right in my recollection that the water in this aquarium had been compounded in the laboratory, such being the common practice of Professor Hudson. By the time I arrived no sign of the medusa could be found, nor did others appear, but Professor Hudson had examined the one specimen carefully and was probably correct in calling it Gonionemus.

It now appears that, at least in the European species, and we can scarcely doubt that the same thing is true of *G. murbachii,* the basal buds which appear late in the season on the polyps are medusa buds. Professor Joseph describes the polyp as producing a series of planula-shaped vegetative buds which drop off almost exactly like those of the common pond hydra. Later buds near the base of the individual assume a more compact form and develop directly into the tentacled medusa.

So many students at Woods Hole and at institutions in which Gonionemus has been used for laboratory illustration of the coelenterates have been informed in text-books and from the lecture desk that the transformation into the free-swimming medusa was a matter of conjecture only that it may interest a considerable number to know of Professor Joseph's success in closing this annoying gap. It is somewhat of a coincidence also that salt water aquaria furnished him with the first clue of the nature of the metamorphosis. Professor Joseph's articles appear in a series of publications, the last of which was the *Zeitschrift f. wissensch. Zoologie,* 125, 1925, p. 374.

H. F. PERKINS
THE UNIVERSITY OF VERMONT

[1] Proceedings Acad. Nat. Sci., Philadelphia, November, 1920, Fig. 15.

THE VALUE OF SOCIOLOGY

PERSONAL culture and social efficiency are two very definite objectives in modern education. The study of sociology will help fulfill both of these objectives. Personal culture to-day is not attained by studying topics that do not pertain to modern conditions, but rather by receiving instruction in subjects that have a direct bearing on the conduct and problems of life. No study will necessarily make a person cultured, but since sociology deals with many current problems it will help make the student cultured from the academic viewpoint.

Dr. C. W. Eliot, in his monograph, "Education for Efficiency," after stressing the importance of character and of literary appreciation and expression, says: "The next great element in cultivation . . . is acquaintance with some part of the store of knowledge which humanity in its progress from barbarism has acquired and laid up. . . ." He says further,

"Culture can no longer imply a knowledge of everything—not even a little knowledge of everything—it must be content with a general knowledge of some things and a real mastery of some small portion of the human store."

Dr. Eliot then asks this question: "What portion or portions of the infinite human store are most proper to the cultivated man?" and answers it by saying: "Those which enable him, with his individual personal qualities, to deal best and sympathize most with nature and with other human beings. It is here that the passion for service must fuse with the passion for knowledge."

Now does it not seem almost self-evident that the student who has studied the principles and problems of sociology "has a better chance of fusing the passion for knowledge with the passion for doing good"—has a better chance of fusing the passion for culture with the passion for service than the student who has neglected to study sociology?

Good citizens attempt to better society and "he is greatest among his fellows who best serves their truest interests." But how can the citizens of to-morrow work toward their ideals? How can they better society—how can they "improve human relations" *unless* they study to find out what present conditions are? The voters of the future must have social knowledge; they must have knowledge concerning actual conditions; they must study the evils as well as proposed remedies; they must know the problems before they can suggest solutions. The practical use of a course in sociology is by no means small, even if we confine the study to elementary problems and measure the value by the strictest of utilitarian rules.

In a few years our students in school and college become voters and have all the duties of citizenship to discharge, and for this reason they should be required to study sociology which will help prepare them for citizenship. Students in school or college may not make great progress in the study of social problems, but a little knowledge may stimulate them to acquire more, and it will certainly give them a deeper interest in the welfare of their country and the well-being of their fellow-citizens. The study of society, contributing as it does a knowledge of complex activities, interests and forces of modern social life, is a good preparation for citizenship.

Sociology will help make the students socially efficient, for, if taught as it should be, it will give the students a sense of awareness of their civic and moral responsibility and the desire and knowledge so they may cooperate intelligently with their fellows in promoting the common welfare. It should contribute to each student's usefulness as well as to each student's happiness. Discussions of social problems will help students to get more out of life, not only by contributing to the enjoyment of leisure, but also by creating the desire or willingness to share effectively in making others better and happier. Sociology ought to help any citizen to work better with his fellowmen for "the continuous improvement and happiness of his race, his nation, his state and his own immediate community."

Finally to summarize: the study of sociology has real cultural value and it helps prepare the students for effective citizenship. It promotes culture and has practical worth for life because, as already stated, it has a direct bearing on the conduct and problems of life. There are four important things that the study of sociology will do for the student. It will (1) help him to enjoy life; (2) prepare him for duty; (3) give him a desire to participate intelligently in the world's work, and (4) help him to render genuine social service. And what else can the study of sociology give that can in any way compare with a sincere desire to have even a small share in solving some of the problems of civilization?

In conclusion, the thought should be stressed that emphasis should be placed on preparing for service because "service is the highest criterion of the worth of lives. We are learning that, whether in history or romance, the names that shine with the fairest and brightest light and last longest are those that have done most service. The great moments in great lives are those when the supreme choice is to be made between self and the welfare of others, and the best criterion of supreme manhood and womanhood is when the latter prevails. More and more enlightened public opinion is coming to distinguish between those who live and die for themselves and those who live and die by the gospel of helpfulness."[1]

RANSOM A. MACKIE

STATE NORMAL COLLEGE,
DILLON, MONTANA

THE DEEPEST HOLE

IN the October 23 issue of SCIENCE a correspondent states that the deepest hole ever drilled is the Miley Oil Company's No. 6 well, located at Athens, Los Angeles County, California. I wish to call your attention to the fact that the Peoples Natural Gas Company's well No. 2 on the Booth-Flynn property at McCance, Ligonier township, Westmoreland County, Pennsylvania, was drilled to a depth of 7,756 feet. This is 165 feet deeper than the Miley Oil Company's well and is, I feel quite sure, the deepest hole ever drilled.

M. E. JOHNSON

[1] R. A. Mackie, "Education during Adolescence," p. 18, E. P. Dutton & Co., N. Y., 1920.

SCIENTIFIC BOOKS

Photoelectricity. By H. STANLEY ALLEN. 2nd Edition. New York: Longmans Green Co.

THE principal experimental facts of photoelectricity were practically all known before the publication of the first edition of Professor Allen's "Photoelectricity." It had been known for a decade, thanks to the work of Lenard, that under illumination, metal plates in vacuo give off electrons whose number varies directly with the intensity, but whose energy of emission depends only on the frequency of the light. The existence of long wave length limits—beyond which no amount of illumination would eject electrons—characteristic of the substance, and falling for different elements in an order clearly related to their positions in the periodic table was already well established. The striking differences in the amount and in wave-length distribution of the emission from specular surfaces of the alkali metals when the plane of polarization of the incident light is changed, had been discussed and extensively studied by Elster and Geitel and by Pohl and Pringsheim.

The problems raised by these phenomena were clearly recognized as being incapable of solution by "classical" theories of radiation, or by reference to any of the known optical properties of matter. The non-dependence of the energy of emission on the intensity of the light, coupled with the instantaneity of photoelectric response, called apparently for an absorption of energy from an area of wave front enormously greater than an atom could command, or for some form of trigger action which seemed ruled out by other well-established phenomena. Einstein had boldly faced this dilemma by proposing his photoelectric equation, based on the assumption that radiant energy travels through space in bundles or "quanta," but his equation lacked experimental verification.

Comparatively little work has been done in the past dozen years leading to the knowledge of new experimental facts. The conditions under which the "normal" and "selective" effects of Pohl and Pringsheim occur have been probed more closely. It has been found that photoelectric emission is not in all cases independent of temperature, as was formerly considered to be the case. The establishment of photoelectric emission as the initial process occurring in typical light sensitive resistances, *e.g.*, crystals, has followed from the work of Gudden and Pohl. Investigation of photoelectric phenomena, in the broad sense of the word "photoelectric," has been much more active in the realm of X-rays, where the influence of surface "work functions" is avoided. DeBroglie has shown that under X-ray excitation the velocities of the "photo" electrons exactly correspond to the various electron rings postulated by the Bohr theory. It is in fact in the correlation of photoelectric phenomena with the quantum theory that the real progress in the subject has been made. Foremost in this direction is the classical work of Millikan, who has verified Einstein's photoelectric equation with such accuracy as to derive from the "stopping potentials" for various wave lengths one of the most accurate determinations of the quantum constant "h." Quite recently (since the book under review was published) Foote and his associates have definitely proved the existence of photoelectric emission from alkali metal vapors due to absorption at the wave lengths indicated by the Bohr theory from spectroscopic considerations—an experimental result which has been sought with indifferent success by many investigators and was finally made possible by utilizing the effect of released positive ions on the space charge around a glowing filament, due to Kingdon.

Thus, although the lines of work which were most actively followed in 1913 have been somewhat neglected, the explanation of certain of the phenomena has been found by collateral work—where by "explanation" we mean that the problems of photoelectricity have been brought within the field of the quantum theory. The process of electron emission by radiation is just as mysterious as ever, but it is the same mystery as the emission of spectrum lines, and the radiation of the black body. With the clearing up of the contradictions presented by the well-established wave theory of radiation in space and the quantum theory of radiation and absorption of energy by matter, the chief problems of photoelectricity may be expected to find their solution.

The second edition of Allen's "Photoelectricity" takes its form from the frankly expressed belief of the author that no change in arrangement has been made necessary by developments since the first. The chapter headings are practically the same. The chief experimental facts are first treated, a discussion and review of theories is given and finally a very interesting and stimulating series of chapters dealing with photography, fluorescence and phosphorescence, photochemical reactions and physiological effects—allied subjects in which it is more and more apparent that photoelectricity plays an important rôle. The book is open to the criticism that it has in fact followed the first edition too closely. The original illustrations have been retained almost throughout, thus exhibiting experimental results which have often been superseded in important details, even though the main phenomena illustrated are the same. Few new illustrations have been added and the description of later work is in consequence less detailed and critical than is the case with the early work, so that the book in-

evitably suffers in perspective. The necessity "to overcome the difficulty of including some references to this work without materially increasing the size of the book" is an unfortunate condition for a scientific writer to have to bow to. The book will, however, be found to be exceptionally complete in its references, and an extensive bibliography of all articles since 1913 opens the way for any one to inform himself in detail on any aspect of the subject.

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SPECIAL ARTICLES

REMARKS ON SURFACE DISTRIBUTION OF MARINE PLANKTON DIATOMS IN THE EAST PACIFIC

THESE remarks are almost entirely based on information obtained by study of material collected mainly in the years 1920, 1921, 1922 and partly in 1923 and 1924. A similar amount of material is on hand awaiting study at the Scripps Institution, but its content is unknown.

Some of the collecting of this material was done from boats and some from piers, but in all cases a measured amount of water, dipped from the surface of the sea, was passed through a small filtration net of No. 25 bolting silk. The material retained by the silk was then preserved in formaldehyde. This method was placed in operation at the Scripps Institution pier in 1919, at Pt. Hueneme pier in 1920, and at Oceanside pier in 1921, where daily catches from seven gallons of water were made throughout succeeding years.

In 1921 a small boat was chartered for the summer which was used for making daily collections from five gallons of water at points five and ten miles seaward from the Scripps Institution pier. A similar series was taken in 1922. In 1920 Dr. McEwen, Scripps Institution hydrographer, made collections from the passenger steamer *Queen* between San Diego and Seattle in daytime running. Following this, Mr. Mortensen, second officer on the *Queen*, made a few catches on each of several round trips between San Diego and Seattle. Earlier in 1920 Mr. Crandall and Mr. Michael, members of the staff of the Scripps Institution, had taken a series of collections on a voyage from Jacksonville, Florida, through the Panama Canal to San Diego on the yacht *Kemah*, belonging to Mr. E. W. Scripps. Most of the aforementioned steamer catches were taken from two and one half to three gallons of water. In 1921 the California Academy of Sciences conducted an expedition into the Gulf of California, on which Dr. Fred Baker, of San Diego, made a series of catches, each taken from three gallons of water.

In 1922 Mr. Barnhart, of the Scripps Institution, obtained a series of catches off the coast of Lower California while a guest on a scientific expedition by the Mexican government. In 1923 the U. S. Coast and Geodetic Survey steamer *Pioneer* took a series of catches seaward from San Diego, and then a fairly continuous (geographically) series while running from San Diego to Alaska and the Aleutian Islands. This series was interrupted for considerable periods of time in certain localities. Early in 1924 Mr. E. W. Scripps, in his yacht *Ohio*, obtained a series between the Canal Zone and Callao, Peru. All these later steamer catches were made by filtering five gallons of water.

From the various sources a total of some thousands of catches was obtained and studied. Since a known volume of water was filtered in each case, the diatom production was uniformly estimated in numbers of cells per liter, thus rendering each catch numerically comparable with any other. Unfortunately, many catches could not be made comparable in any additional feature, except that they were all taken at the surface level.

The geographic area represented in the combination of all these various series is over seven thousand miles in extent in coastal waters of the East Pacific. It comprises more than seventy degrees of latitude and more than ninety degrees of longitude.

The temperature of the water from which collections were taken ranged from 39.4° F. to 84.5° F.

The size of the catches ranged from zero to a total of nearly seven million cells per liter. Largest catches were found in Alaskan waters, but very small catches were also taken there, while catches running into millions of cells per liter have often been taken off the coast of California. Surface catches taken far from land (eighty miles or more) in all latitudes (tropic, sub-tropic and sub-arctic) have all been very small, few reaching the number of one thousand cells to the liter. The available evidence indicates that a certain nearness to land is necessary for good production of diatoms in the East Pacific.

In some cases, in all regions and any season, heavy (also light) production seems to be strongly localized. Some highly productive localities seem to be recurrently (and perhaps permanently) so, while others appear to be more sporadic in such showing. Some localities have always shown small numbers, so far as yet observed.

In all regions, production seems to be usually best in the spring, poorest in late summer and early

winter, and moderately good at some time in fall. Wide variations from this schedule may occur, except that a high (though not always maximum) production is always to be expected at some time in spring.

While we do not yet have evidence in shape for formal presentation, it may be of interest to note that my experience in Southern California gives me the impression that we have much heavier production for one or two years after a season of heavy rainfall than we do in years following light rainfall. This idea is, of course, related to my supposition that heavier production of diatoms reported for high latitudes is largely due to favorable conditions of drainage from land.

The number of species in a catch was rarely as great as forty, and catches of excessive size usually showed a large number of species in spite of the fact that only one or two forms contributed the excessive number of cells. Some species were represented in all territories from Peru to the Aleutian Islands. Most prominent of these was *Chaetoceros debile* Cl. Some species seemed to be more nearly confined to higher latitudes. Prominent amongst these was *Thalassiosira nordenskioldii* Cl.

Many plankton diatoms are exceedingly variable in size, form and appendages. The two ends of a single chain have sometimes been found to exhibit differences characteristic of separate species. The range of variability is not noticeably greater in one area than in another.

Although not strikingly abundant, resting spores were more commonly observed in Alaskan material than in any other.

Our plankton material has not been closely studied for separation of species. In a small number of catches examined by Dr. Mann, of the Carnegie Institution, he reported the finding of a few new species. It is probable that extended search would reveal several new forms from all Pacific regions.

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RICKETS, ULTRA-VIOLET LIGHT AND MILK

THE prevention and control of rickets could probably be accomplished were it possible to furnish to the infant suitable amounts of the anti-rachitic substance in its food, mother's serum, or milk. The fact that ultra-violet light, properly used, will prevent or cure rickets leads to the hypothesis that ultra-violet treatment of the mother might cause the anti-rachitic substance to be increased in the milk which she gave. To test this hypothesis Holstein-Friesian cows of nearly the same age and calving date and receiving like treatment as to feed, temperature, etc., were placed side by side in the university dairy barn. Throughout the experiment these cows did not leave the barn. For one month none of the cows received ultra-violet light. For the second month two cows received ultra-violet light fifteen minutes a day generated from a Cooper-Hewitt alternating current light at three feet above their backs. For the third month these cows received ultra-violet light for thirty minutes a day under the same conditions. In the meantime Rhode Island Red chickens were allowed to develop rickets, shown both clinically and by X-ray photographs. They were divided into two lots, one lot of three chickens receiving milk from the ultra-violet cows, the other of two chickens, milk from the control cows. Both lots received all the milk they wished.

The chickens have now been under treatment fifty days. The lot receiving milk from cows exposed to ultra-violet light are in good condition with no appearance of rickets in X-ray plates. The lot receiving normal milk has moved progressively toward more extreme clinical and X-ray rickets. The experiment has been repeated, using the milk from these same cows on White Leghorn chickens showing clinical and X-ray rickets. Five chickens were in each lot. After thirty-eight days' treatment four of the lot receiving milk from the ultra-violet cows are almost cured of rickets, showing only a very slight stiffness. The fifth chicken shows some stiffness. Four of the lot receiving the normal milk show constantly increasing symptoms of the more advanced stages of clinical rickets. The fifth chicken, with less fully developed rickets at the start of the experiment, now shows little change from its original appearance. Thus while this anti-rachitic milk is an effective agent for the treatment of rickets, it is not in our experience, as immediately effective in treating rickets in severe form as suitable amounts of cod-liver oil or direct exposure of the animal to ultra-violet light.

These results point to the conclusion that more of the substance necessary to cure rickets is absorbed by the cow exposed to ultra-violet light and secreted by her in her milk. The cows prevented from receiving ultra-violet light are not able to secrete this anti-rachitic substance in sufficient quantities to cure or allay the progress of clinical rickets. The results thus point to an environmental factor transmitted by the cow to her offspring through the medium of her milk. It further suggests that the high incidence of rickets in children during the late winter months is due to their mothers' not receiving enough ultra-violet light either during pregnancy or while in lactation. Furthermore, it would appear that cows' milk produced especially for baby feeding